United Nations ST/SG/AC.10/C.3/2014/4

Secretariat

Distr.: General
14 March 2014

Original: English

Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods

Forty-fifth session
Geneva, 23 June – 2 July 2014
Item 2 (b) of the provisional agenda
Explosives and related matters: review of test series 6

Manual of Tests and Criteria

Recommendations for improvement of the Series 6 Tests

Transmitted by the Institute of Makers of Explosives (IME)[1]

Executive summary

1. In this paper, IME:

(a) In Introduction, reports on the status of the review of the Series 6 Tests in the UN Manual of Tests and Criteria;

(b) In Discussion, reviews issues uncovered in two surveys conducted by IME, United States of America and Canada regarding improvement of the test series;

(c) In Annex 2, proposes some revisions to the test series, as outlined in Annex 2; and

(d) In proposals, presents several longer-term issues and reviews that are necessary to complete the review of the test series.

[1] In accordance with the programme of work of the Sub-Committee for 2013-2014 approved by the Committee at its sixth session (refer to ST/SG/AC.10/C.3/84, para. 86 and ST/SG/AC.10/40, para. 14).

Introduction

2. At the thirty-ninth session of the Sub-Committee, the Working Group on Explosives (EWG) discussed issues of difficulty in conducting tests outlined in the UN Manual of Tests and Criteria, and recommended to the Sub-Committee[2] that the EWG conduct a review of the tests mentioned in Parts I and II of the manual with a view to:

(a) Better defining the specifications of the tests,

(b) Better defining the tolerances associated with those specifications, and

(c) To remove any unnecessary or over-specifications.

3. The expert from Australia offered to coordinate a survey of experts on the basis of permitted variations to Test Series 8 and IME offered to coordinate the work, along with United States of America and Canada, on Test Series 6 (TS6).

4. The Sub-Committee agreed that this work should be carried out[3].

5. As a first step in the review of TS6, IME, along with United States of America and Canada, conducted a survey to obtain comments, observations, and experiences in performing TS6. At the forty-first session of the Sub-Committee, IME reported initial results of this survey in informal document INF.33 (41st session).

6. The Sub-Committee welcomed the report from IME and requested that it expand the distribution of the survey and to report back at its forty-third session. IME conducted the second survey and, at the forty-third session, presented in informal document INF.9 (43rd session) a lengthy review of the survey results.

7. At the forty-third session, there was insufficient time for the explosives working group to review informal document INF.9 in any detail. IME volunteered to lead an informal group review during the interim between the forty-third session and the forty-fifth session and to prepare a report of that work. However, IME was unable to accomplish this coordinated review within the time constraints necessary to finalize a paper by the deadline for forty-fifth session working papers.

8. Some of the issues identified in the surveys and discussed in informal document INF.9 can be addressed in the short term; however, others will require an extended period of study and possible experimentation to resolve.

9. As noted above, informal document INF.9 provided a thorough discussion of the results of the surveys. So that it is less likely that the Sub-Committee will need to refer back to informal document INF.9, much of that discussion is provided below. Informal document INF.9 also contained a lengthy summary of survey results, which is not included herein. Should it be desirable to review those survey results, please refer to informal document INF.9.

Discussion

10. Purpose of the tests in the Manual of Tests and Criteria. As stated in the section 1.1.1 of the Manual, the purpose of these tests is to provide (emphasis added) "… competent authorities with the necessary information to arrive at a proper classification of substances and articles for transport." This has been the stated purpose since the Manual was first

[2] Informal document INF.58 (39th session), para. 13

[3] ST/SG/AC.10/C.3/78, paras. 24 – 25

published in 1986 and has remained unchanged through the twenty-eight years that the Manual has been in use.

11. Many of the comments and suggestions received in the two surveys have to do with attempts to use these tests for purposes other than classification of substances and articles for transport. This is undoubtedly a side-effect of the needed development and implementation of the GHS, which requires proper classification of chemicals so that the dangers from their use and handling can be appropriately communicated to those who may come in contact with them.

12. Although, in many instances, the tests in the Manual may be appropriate for this purpose, often, especially in the case of explosive articles, this is not the case. For example, when testing explosives in Test Series 6 (TS6), explosive articles are most often tested in transport packaging, because they are generally transported in packaging and the outcome of those tests, and the ultimate classification, is often highly dependent upon that transport packaging. Stated another way, an explosive that, when handled in its transport packaging, may be in Division 1.4, may present significantly different hazards when handled outside of that packaging. For the GHS to be effective, this difference must be recognized, and often, that may only be apparent by testing.

13. IME is of the opinion that, while testing for hazards under GHS important, it is imperative that the transport nature of the current tests in the Manual, and especially TS6, remain unaltered. To attempt to adapt the current tests to make them relevant to GHS (or other purposes) could result in unintended and inappropriate changes to the transport classification of those explosives. In instances where TS6 is not fully relevant for a GHS evaluation, IME is of the opinion that separate tests, appropriate for purpose, should be developed and placed in a new part of the Manual containing classification procedures, test methods and criteria relating to the GHS. Such a new part to the Manual has been described in ST/SG/AC.10/C.3/2013/58 and ST/SG/AC.10/C.4/2013/6 and agreed to in principle by the TDG and GHS Sub-Committees at their 44th and 26th sessions respectively.[4]

IME recommendations

(a) Retain the transport nature of TS6.

(b) When a need is demonstrated for a test or tests that are for purposes other than transport classification, develop new tests and place them in a new part of the Manual containing classification procedures, test methods and criteria relating to the GHS.

14. Historical background of the tests. It should be recalled that TS6 was developed in the 1980s and was first published in the first edition of the Manual in 1986. Many, if not all, of those who prepared the first edition of the Manual, and specifically TS6, are no longer active within the Sub-Committee. IME believes that it would be prudent and helpful to future custodians and users of the Test Manual if some notes were prepared and included in the Test Manual relating to how and why the tests in series 6 were developed.

15. Sequence of performance and waiver of tests. Section 16.2.2 describes the order of test performance and the conditions under which tests may be waived. This section does not address the potential waiver of the 6(a) and 6(b) tests if the 6(d), when required, has been passed. This waiver was discussed by the EWG and endorsed by the Sub-Committee at its

[4] ST/SG/AC.10/C.3/88, paras. 108 – 109 and ST/SG/AC.10/C.4/52, paras. 9 – 11

thirty-fifth session.[5] Additionally, the structure of the section makes it difficult to determine what order changes and/or waivers may be appropriate. Finally, for the 6(a), 6(b) and 6(d) tests, some of those who responded to the surveys questioned why these test are required of articles that are shipped without a means for initiation or ignition or otherwise designed such that functioning within the transport package is prevented. This is an issue that has been considered by the Sub-Committee and its EWG, yet the question continues to arise. Currently, no guidance on this topic is provided in the Manual and IME believes that it would be helpful to the users if such guidance were provided to help in understanding these tests.

IME recommendations

(a) Section 16.2.2 should be revised to indicate that, if 6(d) is required, it should be performed first.

(b) Section 16.2.2 should be revised to indicate that, if 6(d) is required and has been passed, 6(a) and 6(b) may be waived.

(c) Section 16.2.2 should be restructured to make its reading and interpretation easier.

(d) The Sub-Committee should consider whether some guidance should be provided, in reference to the 6(a), (b), and (d) tests, to applicability of the tests regardless of whether the products can function in the transport packaging.

16. **Test 6(a)**

(a) Purpose of the test. As described in section 16.4.1.1, the purpose of the test is to determine if there is a mass explosion of the contents in a single package. Most of those who responded to the surveys agreed that this purpose was clear; however, some found the heading "Introduction" somewhat misleading, since the section actually discusses the purpose of the test. Additionally, despite the guidance provided in section 16.2.4, some were unclear of the meaning of the term "mass explosion".

IME recommendations

(i) Revise the heading of section 16.4.1.1 to read "Purpose". This revision is also suggested for sections 16.5.1.1, 16.6.1.1 and 16.7.1.1.

(ii) Insert the following sentence at the end of section 16.4.1.1 of the Test Manual:

See Appendix B of the Model Regulations for the definition of "mass explosion".

(iii) Review the definition of "mass explosion" in Appendix B of the Model Regulations to ensure that it is still appropriate and clear in its meaning.

(b) Test materials. The majority of survey responses indicated that the materials required to perform the test were adequately described. However, one significant issue that was called to attention was that of the "standard detonator" described in section 16.4.1.3.2, which, as several respondents noted, is not available as specified. A quick survey by IME of several test agencies revealed that, when a test specifies

[5] ST/SG/AC.10/C.3/70, para. 18 and informal document INF.57 (35th session)

use of a "standard detonator", a commercially available detonator believed to provide equivalent results is used. The table in Annex 1 provides specifications of detonators identified to IME as being used in place of the "standard detonator" referred to in the Manual.

The list in section 16.4.1.2 appears to imply that both a detonator and an igniter are required. Based upon the guidance provided in sections 16.4.1.3.2 and 16.4.1.3.3, IME does not believe that this is the case, and this should be clarified.

Suggestions were received to include more sophisticated means of blast characterization such as the effect of donor action on receptors, projection hazards, etc. IME disagrees with these recommendations as it understands that the 6(a) test is intended to be a relatively basic, simple mechanism for determining if there is a mass explosion hazard. While possibly relevant to GHS evaluations, other blast characteristics are relevant to the transport nature of the 6(a) test and are not examined. Such an evaluation may be a likely subject for new GHS-related testing as discussed in para. 10 above.

When considering the mild steel witness plate prescribed in the 6(a) procedure, from survey responses, it appears that the 3.0 mm specification contained in section 16.4.1.2 is adequate. Since the purpose of this test is to determine if a mass explosion has occurred, it does not appear that the thickness of the witness plate is of particular significance. However, 3.0 mm thick mild steel may be difficult to obtain in some parts of the world and alternatives should be provided for.

IME recommendations

(i) The Sub-Committee should revise Appendix 1 of the Manual to specify broader criteria for detonators that can be used as a "standard detonator" pending a more detailed study on more appropriate criteria, and should commence such a study.

(ii) Revise the list in section 16.4.1.2 as follows:

(a) A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.4.1.3.2 and 16.4.1.3.3);

(b) Suitable confining materials (see 16.4.1.3.4); and

(c) A sheet of 3.0 mm thick mild steel (or equivalent mild steel such as 11 gauge or CR4 grade) to act as a witness plate.

(iii) Reword the comment at the end of section 16.4.1.2 to read as follows:

***NOTE:** In some cases, blast measuring equipment may be necessary.*

Revisions similar to those in ii) and iii) above should also be made to sections 16.5.1.2 and 16.7.1.2.

(c) Acceptance criteria. It appears that the indicators of mass explosion described in section 16.4.1.4 are leading some to conclude that any occurrence of any one of them is a failure. IME believes this is not necessarily true and that (a) - (d) of section 16.4.1.4 are offered to assist in evaluating whether a mass explosion has occurred. For example, if there is damage to the witness plate, yet the package contained 50 items of which 48 were recovered unexploded, clearly, mass explosion has not occurred. However there is a perception that the damaged witness plate is automatically a failure of the 6(a) test and requires assignment to Division 1.1, even though a mass explosion obviously didn't occur.

Some comments were received suggesting that package orientation should be varied in each of the three 6(a) trials. Since the purpose of the 6(a) test is to determine if mass explosion occurs, package orientation seems immaterial. Package orientation would be important if examining projection effects, but this is not the purpose of the 6(a) test.

IME recommendations

(i) Review the criteria to ensure that they don't conflict with the definition of "mass explosion" provided in Appendix B of the Model Regulations.

(ii) Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

(iii) Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

17. **Test 6(b)** – Most of the discussion in para. 13 above is also applicable to Test 6(b) and won't be repeated here.

IME recommendations:

(a) Review the criteria to ensure that they don't conflict with, or lead one away from, the stated purpose of the test, that is to determine if there is package-to-package propagation.

(b) Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

(c) Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria. Some comments were received that indicate that some parties think that the 6(b) test is used for purposes other than as stated in section 16.5.1.1, that is, to determine if there is package-to-package propagation.

18. **Test 6(c)**

(a) Purpose of the test. Judging by the results of the survey, the purpose of the 6(c) test appears to be adequately defined. As noted previously, the heading of this section and comparable sections in 6(b) and 6(d) should be revised to read "Purpose".

Some concern was expressed that the phrase "… or any other dangerous effect …" might be ambiguous and could lead to misclassification resulting from a determination that burning packing material, the fuel itself, etc. might be considered a "dangerous effect". IME is of the opinion that some clarification should be provided.

IME recommendations

(i) Revise the heading of section 16.6.1.1 to read "*Purpose*". This revision is also suggested for sections 16.4.1.1, 16.5.1.1 and 16.7.1.1.

(ii) Revise the ending of section 16.6.1.1 to read something like, "*… or any other explosives-caused dangerous effect when involved in a fire.*"

(b) Test materials. The majority of those responding to the surveys agreed that the 6(c) test materials were adequately described. Some commented that, in section

16.6.1.2(c), an inappropriate mesh size could, after the packaging begins to burn away, result in the tested product falling into the fire rather than remaining on grid, thus confusing interpretation of the test. Some clarification on this point is recommended.

Materials to construct the witness panels described in section 16.6.1.2(g) don't appear to be universally available to test labs. IME is of the opinion that alternative materials for witness panel construction should be allowed and suggests that the EWG review witness panel specifications, with the goal of providing some guidance regarding acceptable alternatives.

IME recommendations

(i) Insert a sentence between the first and second sentences of 16.6.1.2(c) to read as follows:

The upper surface, or mesh, of the grid, upon which the tested explosives are placed, should be of sufficient size to prevent the tested explosives from falling into the fire after any packaging, if present, begins burning away.

(ii) Reword the comment at the end of section 16.6.1.2 by inserting "Note: " at the beginning of the statement.

(iii) The EWG should conduct a review of witness panel specifications, with the goal of providing some guidance regarding acceptable alternatives.

(c) Test Specifications. The main issues identified in the survey regarding 6(c) test specifications were fuel sources and construction of the fire. Of particular concern was the description of a "suitable method" of building a wood fire that is found in section 16.6.1.3.2. It appears that some take this very expensive method as the only way to build a wood fire and that fires built of other lumber or wooden pallets are unacceptable. This issue was discussed and resolved at the TDG's forty-third session.[6]

Additionally, several comments were received that the procedure seemed less organized than those for 6(a), 6(b), and 6(c).

IME recommendations

(i) The EWG should review fuel sources for the test to determine if other methods are available that will serve the purpose, be readily available, and more environmentally friendly.

(ii) The EWG should review the structure of the procedure to improve its readability and comprehension.

(d) Acceptance criteria. The acceptance criteria in section 16.6.1.4 are confusing to many users. Some of the questions concerned the definition of "mass explosion" (see also para. 13.a) above), assessment of fireballs and jets of flame, calculation of burning time, assessment of witness panel dent depth, and calculation of the mass-distance relationship when trying to evaluate energy of metallic projections.

---

[6] ST/SG/AC.10/C.3/86 (para. 13), ST/SG/AC.10/C.3/86/Add.1, ST/SG/AC.10/C.3/2013/27, and informal document INF.61/Rev.1 (43rd session).

It was observed that the second sentence in section 16.6.1.4.2 is inconsistent with the definition of "mass explosion" as provided in Appendix B of the Model Regulations. IME agrees and recommends that this be corrected.

A suggestion was received that terms such as "fireball", "jet of flame", "fiery projection", and "metallic projections" be defined so that there will be more consistent interpretation and application of the 6(c) acceptance criteria.

It was observed that the concluding phrase of section 16.6.1.4.6, which addresses hazardous effects being confined within the package, is not an evaluation possible in the 6(c) test, since the package has most likely been consumed in the fire. Some of those responding to the survey questioned why this statement is in the assessment criterion that leads to 1.4S. This issue was discussed and resolved at the forty-third session.[7]

There seemed to be general confusion and lack of understanding of the significance of certain criteria, such as the energy level limits (8J and 20J) for metallic projections, the thermal flux and burning time criteria, dent depth limits, and so forth. Much of this information is contained in discussion documents that were developed during the review of the 6(c) test by the EWG in the 1990s. IME is in possession of most, if not all, of these historical discussion documents and suggests that it might be worthwhile to include some of this information in an introductory paragraph to the procedure so that users will understand their significance (see also the discussion in para. 11 above).

The validity of the points on the curve and the data in the table in Figure 16.6.1.1 was questioned. Some observed that the data presented has not been borne out in their practical test experience.

IME recommendations

(i) Revise section 16.6.1.4.2 by replacing the 2nd sentence with:

See Appendix B of the Model Regulations for the definition of "mass explosion.

(ii) Develop definitions for the terms "fireball", "jet of flame", "fiery projection", and "metallic projections".

(iii) Review the graph and data in Figure 16.6.1.1.

19. **Test 6(d)** Most of the discussion above about Test 6(a) is applicable to Test 6(d) as well. Some issues specific to the 6(d) acceptance criteria in section 16.6.7.1.4 are reviewed below.

(a) 16.7.1.4(a). Concern was expressed that minor nicks and scratches might be interpreted as "denting" as described in section 16.7.1.4(a). This has been discussed in past meetings of the Working Group on Explosives, and IME recalls that this is not the case. Some guidance to this effect should be provided in section 16.7.1.4.

(b) 16.7.1.4(b). The feeling is that the words "capable of" are too vague. IME agrees and suggests that a revision of this criterion be considered.

[7] ST/SG/AC.10/C.3/86 (para. 13), ST/SG/AC.10/C.3/86/Add.1, ST/SG/AC.10/C.3/2013/27, and UN/SCETDG/43/INF.61/Rev.1 as amended.

(c) Section 16.7.1.4(c). This section describes disruption of the packaging causing projection of the explosive contents. If this occurs, assignment to 1.4S is not possible. The question has been posed that, if the entire outer package is blown away, yet all of the contents remained in the area of the confines of the package, would this be considered a pass or a fail? IME believes that, in this example, since the explosive contents were not projected, that this would be a pass. However, discussions at a past meeting of the IGUS/EPP and at a past Chief Inspectors of Explosives conference indicate that there is not a consensus of agreement on this interpretation. Some clarification is needed and this could possibly be assisted by inclusion of some additional specific examples.

IME recommendations

(i) Provide some guidance regarding what denting is and what it is not.

(ii) Revise section 16.7.1.4(b) as indicated below:

A flash or flame ~~capable of igniting~~that ignites an adjacent material such as a sheet of 80 ± 3 g/m² paper at a distance of 25 cm from the package.

(iii) Consider providing some guidance regarding the issue described above concerning the outer package being blown away.

(iv) Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

(v) Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

Proposals

20. The Sub-Committee is invited to consider the proposed revisions to the Manual as described in the Annex 2.

21. The Sub-Committee is invited to discuss:

(a) Retention of the transport nature of TS6 and how best to ensure this retention in the future.

(b) Development, as needed, of new tests for purposes other than transport classification and placement of those tests in a new part to the Test Manual containing classification procedures, test methods and criteria relating to the GHS.

(c) Whether notes should be prepared and included in the Test Manual describing how and why the series 6 tests were developed.

(d) Whether some guidance should be provided, in reference to the 6(a), (b), and (d) tests, to the applicability of those tests regardless of whether the products can function in the transport packaging.

(e) Commencement of a review by the EWG of the 6(a) test to include:

(i) a review of the definition of "mass explosion" in Appendix B of the Model Regulations is needed to ensure that it is still appropriate and clear in its meaning;

(ii) a revision of Appendix 1 of the Manual to specify broader criteria for detonators that can be used as a "standard detonator" pending a more detailed study on more appropriate criteria.

(iii) a detailed study as described in para. 18.e)ii) above.

(iv) a review of sections 16.4.1.4 and 16.4.1.5 to:

(1) ensure that the criteria provided don't conflict with the definition of "mass explosion" provided in Appendix B of the Model Regulations;

(2) ensure that it is clear that the examples in section 16.4.1.5 are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria; and

(3) develop additional examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

(f) Commencement of a review by the EWG of sections 16.5.1.8 and 16.5.1.9 to:

(i) ensure that the criteria they don't conflict with, or lead one away from, the stated purpose of the test, that is to determine if there is package-to-package propagation;

(ii) ensure that it is clear that the examples in section 16.5.1.9 are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria; and

(iii) develop additional examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

(g) Commencement of a review by the EWG of the 6(c) test to include:

(i) witness panel specifications, with the goal of providing some guidance regarding acceptable alternatives;

(ii) fuel sources, to determine if other methods are available that will serve the purpose, be readily available, and more environmentally friendly;

(iii) the structure of the procedure to improve its readability and comprehension;

(iv) development of definitions for assessment terms such as "fireball", "jet of flame", "fiery projection", and "metallic projections"; and

(v) a review of the graph and data in Figure 16.6.1.1.

(h) Commencement of a review by the EWG of the 6(d) test to include:

(i) a review of the meaning of the term "denting" and development of appropriate guidance;

(ii) guidance regarding the issue described in para. 16.c) above concerning the outer package being blown away;

(iii) development of some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.;

(iv) clarification that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

Annex 1

Detonators reported to be used by test agencies in place of the UN "Standard Detonator" specified in Appendix 1 of the Manual of Tests and Criteria

Country	Test Agency	Manufacturer	Detonator	Total Load (mg)	Output		Other		Notes
					mg	Expl.	mg	Expl.	
				600	*400*	*PETN @440 bar*	*200*	*PETN @20 bar*	European
				642	*447*	*PETN @280 bar*	*195*	*LA*	US #8
Canada	NRCan	Dyno	Dyno DiPed	950	875	PETN	75	LA	
Canada	NRCan	Orica	Exel SHD	0					Shock tube
USA	EMERTC	Teledyne RISI	RP-81	530	450	RDX	80	PETN	EBW
Australia	Australian Munitions	Any		NEQ+					Spec Det not available in Australia
USA	Explosives Examiners	Petro-Explo	RJ-333/EBW or A4-139	530	350	RDX	180	PETN	Part number uncertain
Netherlands	TNO	Orica	Dynadet-C2-0ms		unk		unk		
USA	APT	Teledyne RISI	RP-80	203	123	RDX	80	PETN	EBW

Annex 2

Changes for the test Manual (5th revised edition)

Section 16.2.2 – Revise as indicated below:

16.2.2 Test types 6 (a), 6 (b), 6 (c) and 6 (d) are normally performed in alphabetical order. However, it is not always necessary to follow this order or to conduct tests of all types.

(a) Test type 6 (a) may be waived if explosive articles are carried without packaging or when the package contains only one article (see also section 16.2.2 (d)).

(b) Test type 6 (b) may be waived if in each type 6 (a) test (see also section 16.2.2.(d)):

(a)(i) The exterior of the package is undamaged by internal detonation and/or ignition; or

(b)(ii) The contents of the package fail to explode, or explode so feebly as would exclude propagation of the explosive effect from one package to another in test type 6(b).

(c) Test type 6 (c) may be waived if, in a type 6 (b) test, there is practically instantaneous explosion of virtually the total contents of the stack. In such cases the product is assigned to Division 1.1.

(d) Test type 6(d) is a test used to determine whether a 1.4S classification is appropriate and is only used if special provision 347 (a) of Chapter 3.3 of the Model Regulations applies. When testing articles to which special provision 347 applies, test type 6(d) is performed first. If the results of test type 6(d) indicate that a 1.4S classification is appropriate, then test types 6(a) and 6(b) may be waived.

~~The results of test series 6 (c) and 6 (d) indicate if 1.4S is appropriate, otherwise the classification is 1.4 other than S.~~

Section 16.4.1.1 – Revise as indicated below:

16.4.1.1 ~~*Introduction*~~*Purpose*

This is a test on a single package to determine if there is mass explosion of the contents. See Appendix B of the Model Regulations for the definition of "mass explosion".

Section 16.4.1.2 – Revise as indicated below:

16.4.1.2 *Apparatus and materials*

The following items are required:

(a) A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.4.1.3.2 and 16.4.1.3.3);

~~(b) An igniter just sufficient to ensure ignition of the substance or article;~~

(~~c~~b) Suitable confining materials (see 16.4.1.3.4); and

(~~d~~c) A sheet of 3.0 mm thick mild steel (or equivalent mild steel such as 11 gauge or CR4 grade) to act as a witness plate.

Note: In some cases, bBlast measuring equipment may be ~~use~~necessary.

Section 16.5.1.1 – Revise "Introduction" to read "Purpose"

Section 16.5.1.2 – Revise as indicated below:

16.5.1.2 *Apparatus and materials*

The following items are required:

(a) A detonator to initiate the substance or article of an igniter just sufficient to ensure ignition of the substance or article (see 16.5.1.4 and 16.5.1.5);

~~(b) An igniter just sufficient to ensure ignition of the substance or article;~~

(~~c~~b) Suitable confining materials (see 16.5.1.3); and

(~~d~~c) A sheet of 3.0 mm thick mild steel (or equivalent mild steel such as 11 gauge or CR4 grade) to act as a witness plate.

Note: In some cases, b~~B~~last measuring equipment may be ~~used~~necessary.

Section 16.6.1.1 – Revise as indicated below:

16.6.1.1 *~~Introduction~~Purpose*

This is a test performed on packages of an explosive substance or explosive articles, or unpackaged explosive articles, to determine whether there is a mass explosion or a hazard from dangerous projections, radiant heat and/or violent burning or any other explosives-caused dangerous effect when involved in a fire.

Section 16.6.1.2 – Revise as indicated below:

16.6.1.2 *Apparatus and materials*

The following items are needed:

(a) – (b) No changes proposed

(c) A metal grid to support the products above the fuel and allow adequate heating. The upper surface, or mesh, of the grid, upon which the tested explosives are placed, should be of sufficient size to prevent the tested explosives from falling into the fire after any packaging, if present, begins burning away. If a wooden crib fire is used, the grid should be 1.0 m above the ground and if a liquid hydrocarbon pool fire is used then the grid should be 0.5 m above the ground;

(d) – (h) No changes proposed

Note: Blast gauges, radiometers and associated recording equipment may also be used.

Section 16.6.1.4.2 -- Revise as indicated below:

16.6.1.4.2 If mass explosion occurs then the product is assigned to Division 1.1. See Appendix B of the Model Regulations for the definition of "mass explosion ~~A mass explosion is considered to occur if a substantial proportion explodes so that the practical hazard should be assessed by assuming simultaneous explosion of the whole of the explosive content of the packages or unpackaged articles.~~

Section 16.7.1.1 – Revise "Introduction" to read "Purpose"

Section 16.7.1.2 – Revise as indicated below:

16.7.1.2 *Apparatus and materials*

The following items are required:

(a) A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.7.1.3.2);

~~(b) An igniter just sufficient to ensure ignition of the substance or article;~~

(cb) A sheet of 3.0 mm thick mild steel (or equivalent mild steel such as 11 gauge or CR4 grade) to act as a witness plate.

Note: In some cases, video equipment may be ~~used~~necessary.

Section 16.7.1.4(b) – Revise as indicated below:

A flash or flame ~~capable of igniting~~that ignites an adjacent material such as a sheet of 80 ± 3 g/m² paper at a distance of 25 cm from the package